REMARKS

This application, as amended herein, contains claims 12-36, and newly added claims 37-39. Claims 1-12 have been canceled, subject to presentation in a divisional application. Claims 18-20 and 24-27 stand withdrawn due to restriction, but may be rejoined, subject to the allowance of a generic claim, and in particular to the allowance of claim 12, as amended herein.

Claims 12-17, 21, 23 and 28-30 were rejected as obvious over Sakaida et al. Claim 22 was rejected as obvious over Sakaida et al. in view of Kanno. Claims 31-36 were rejected as obvious over Sakaida et al. in view of Vinciarelli et al. In view of this amendment, and the Remarks herein, these rejections are respectfully traversed.

Applicants' invention, as set forth in claim 12, as amended herein, is directed to an apparatus for filing vias in a wafer, comprising a chamber in which to place the wafer, said chamber being capable of being evacuated; a surface upon which to place said wafer; a pressurized paste delivery portion for providing a paste to fill said vias; and a pressurized paste filling portion for bringing said paste into contact with said vias under pressure so that said paste fills said vias.

Sakaida et al. actually teaches away form Applicants' invention, as set forth in claim 12. Specifically, Sakaida et al. teaches an evacuated paste delivery portion, and not a pressurized one, as specifically set forth in claim 12. In fact, Sakaida et al. shows in Figs 1, 5 and 7, and states, at column 10, line 60, that "The paste chamber 9 is connected to

a vacuum pump 15."

Sakaida et al. merely states that "Positioning each sliding member 12 in a reclined relationship with the substrate surface makes it possible to produce a force for pushing the conductive paste 13 into the via holes 21 at the given angle." It does not state that there is a pressurized paste filling portion. It cannot do so, when in fact the paste delivery and filling portions are under a vacuum supplied by vacuum pump 15. In view of the above, it is submitted that claim 12 is directed to patentable subject matter.

To distinguish from Sakaida et al. even more specifically, original claim 23, which depends from claim 1, states that the paste delivery portion comprises a pressurized paste reservoir. Three is no such structure in Sakaida et al. As noted above, in Sakaida et al. the paste chamber 9 is not pressurized, but is instead connected to vacuum pump 15. Thus, again Applicants' invention is fully distinguishable from Sakaida et al. wherein the past filling chamber 9 is not pressurized, but is evacuated. Again, Sakaida et al. actually teaches away from Applicants' invention. In view of the above, it is submitted that claim 23 is also directed to patentable subject matter.

Newly added claims 37-39 further distinguish Applicants' invention from the Sakaida et al. Claim 37 states that the wafer is disposed entirely within the chamber that is evacuated. Claim 38 states that the paste filling portion is disposed entirely within the chamber. Claim 39 states that the wafer and the paste filling portion are both disposed

entirely within the chamber. Support for these claims may be found in the drawings and throughout the specification.

Applicants' invention, as set forth in claims 37-39 offer extremely significant advantages over the apparatus of Sakaida et al. Specifically, Sakaida et al. states that, using the arrangement therein (wherein only the paste chamber 9 and the scavenging chamber 5 are evacuated (Figs. 1, 5 and 7)), even if the conducting filling operation is successfully accomplished, in the paste chamber 9, the conductive paste 13 may be sucked out of the via hole 21 when the paste relocates into the scavenging chamber. This results in partial removal of the paste from via hole 21 (Sakaida et al., column 13, lines 26-34). In Sakaida et al., a second filling operation is required (column 13, lines 36-46).

By placing the entire wafer and/or the paste filling portion of the apparatus within the chamber which is evacuated, as set forth in newly added claims 37-39, this problem is entirely avoided. Gas may be selectively removed from the chamber, and the via filling operation conducted by a pressurized paste filling portion, thus avoiding the problems of the apparatus of Sakaida et al. Thus, it is submitted that claims 37-39 are patentably distinguishable from Sakaida et al.

The remaining claims depend from claim 12. These claims have further recitations, which in combination with those of claim 12, are not shown or suggested in the art of record.

Claim 13 recites that the paste filling portion provides the paste at a pressure within the range of 10 to 100 PSI. There

is no specific mention of this range within Sakaida et al. Further, simply pushing conductive paste into the via holes using members 12 cannot possibly control the pressure to be within any particular range. Thus it is submitted that claim 13 is directed to patentable subject matter.

Claim 14 has been amended to recite that the paste filling portion comprises a planar surface onto which paste is deposited; and a mechanism for applying pressure so that paste on the surface is forced into contact with the wafer. Members 12 of Sakaida at al. are simply not planar and extend outward at an angle so as to push the conductive paste. Thus it is submitted that claim 14 is also directed to patentable subject matter.

Claim 16 recites a plate, which defines the planar surface and components for applying a pressure differential to the plate so as to force the plate toward said wafer. Again, Sakaida et al. has no such structure. It is thus submitted that claim 16 is also directed to patentable subject matter.

Claim 28 recites that the paste filling portion comprises an elongate member having a surface with a slot through which paste is provided to said wafer; and a compliant seal for sealing the surface to the wafer. Sakaida et al. have no such elongate member. To the contrary, in Sakaida et al. all the seals are in the form of an annular rings. Thus, Sakaida et al. does not provide precise control as to where the paste is deposited, as does this structure of Applicants' invention, as set forth in claim 28. Accordingly it is submitted that claim 28 is patentable.

Claim 30, which depends from claim 28, recites a mechanism for rotating the member and the wafer with respect to one another so as to fill vias in successive portions of the wafer. The paste application head of Sakaida et al. does not rotate but in fact orbits (Sakaida et al., column 11, lines 40-44). Thus, claim 30 is directed to patentable subject matter.

Claim 32 recites that the apparatus is configured to accept a circular wafer, wherein the elongate member is disposed radially with respect to the wafer. No such structure is taught or suggested by either Sakaida et al. or Viciarelli. Thus, claim 32 is also directed to patentable subject matter.

Claim 33, which depends from claim 32, states that the elongate member has a length less than that of a radius of the wafer, and that the apparatus further comprises a mechanism for rotating the wafer; and a mechanism for radially translating the member in a radial direction with respect to the wafer. In this respect, Vinciarelli adds nothing to Sakaida et al. There is no such the elongate member taught in either one of these documents. Further, the rotation of the base in Vinciarelli does not cover any additional surface area containing any additional vias, but, as noted by the Examiner, simply allows more complete filling of a module from a single opening due to a centrifugal force. Thus, it is respectfully submitted that the rejection of claim 33 should be withdrawn.

Claim 35 advantageously recites a translation speed control to control speed of translation of the member with respect to the wafer. Such speed control, which may be helpful under certain

conditions to assure filling of vias, is not disclosed or suggested in Vinciarelli or Sakaida et al. Thus, it is submitted that claim 35 is patentable.

Claim 36 recites that the mechanism for radially translating the member includes a worm gear assembly and a motor for rotating a drive shaft of said assembly. Again, the documents cited against claim 36 do not teach or suggest this arrangement. Accordingly, it is submitted that claim 36 is also directed to patentable subject matter.

It is noted that while the present invention, as set forth in the claims as amended herein, patentably distinguishes from the art cited by the Examiner, Applicants makes no admission that this art is prior art with respect to this application, and reserve the right to antedate any reference.

Two additional machine translations of references cited in the Information Disclosure Statement mailed on January 9, 2008 are enclosed herewith. It is respectfully requested that the Examiner use these, as well as the previously supplied machine translations, to assist in making the cited prior art of record.

A check in the amount of $1,050 for an extension of time of three months for the filing of this paper is enclosed.

Respectfully submitted,

David Aker 1/14/2008

David Aker, Reg. No. 29,277 Date
23 Southern Road
Hartsdale, New York 10530 Tel. & Fax (914) 674-1094

S/N 10/700,327

Translation Of JP 2003-133723

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The conductive paste restoration approach to the minute beer characterized by controlling squeegee passing speed so that it may face filling up with a conductive paste the minute beer prepared in the base material and the product of the viscosity of a conductive paste and squeegee passing speed supplied ahead of the migration direction of the squeegee to said base material may become fixed.
[Claim 2] The conductive paste restoration approach according to claim 1 which faces filling up with a conductive paste the minute beer prepared in the base material, carries out adhesion maintenance of the rear-face side of said base material, carries out the adhesion arrangement of the squeegee at the front-face side of said base material, and is characterized by to control the passing speed of said squeegee to supply a conductive paste ahead of the migration direction of said squeegee, and for the shearing-stress detector attached in the squeegee edge to detect shearing stress, and to become fixed shearing stress.
[Claim 3] The conductive paste restoration approach according to claim 2 characterized by detecting shearing stress with the shearing stress detector which makes a strain gage the detection section.
[Claim 4] The conductive paste restoration approach according to claim 2 characterized by controlling the passing speed of said squeegee so that the detection value of said shearing stress detector may turn into a value of shearing stress when the best restoration condition beforehand searched for in the experiment is shown.
[Claim 5] The pedestal for carrying out maintenance immobilization of the base material which prepared minute beer, and the version frame which contacts the periphery section except the paste restoration field of said base material laid in the top face of said pedestal, The squeegee which makes said minute beer fill up with the paste supplied by being displaced relatively to said base material, Paste restoration equipment characterized by controlling the passing speed of said squeegee so that it has a squeegee drive, a squeegee control circuit, and a shearing stress detector for detecting shearing stress and said shearing stress becomes fixed.
[Claim 6] Paste restoration equipment according to claim 5 characterized by attaching the shearing stress detector in a squeegee edge.
[Claim 7] Paste restoration equipment according to claim 5 characterized by attaching the shearing stress detector in the rise-and-fall shaft of a squeegee.
[Claim 8] Conductive paste restoration equipment according to claim 5 characterized by preparing the squeegee control circuit which controls a squeegee actuation circuit so that it may be in agreement with the value of shearing stress when the best restoration condition is shown as a result of the experiment which the detection value acquired by

the shearing stress detector conducted beforehand.
[Claim 9] The conductive paste restoration approach which is the approach of filling up with a conductive paste the minute blind via prepared in the base material, puts said base material into a predetermined vacuum dome, carries out degassing of the air bubbles in a minute blind via and a conductive paste after making a conductive paste fill up with an approach according to claim 2 into a minute blind via, carries out atmospheric-air disconnection and is again characterized by to fill up a paste with the approach of claim 2 into a minute blind via after that.
[Claim 10] The version frame installed on the installation base equipped with the O ring put on the O ring slot, A guide shaft, a squeegee, a squeegee base material, and a squeegee drive, A squeegee control circuit and the shearing stress detector attached in the edge or squeegee base material of a squeegee, The 1st stage which consists of vertical rise-and-fall guide shafts, and the flange installed on said installation base, It consists of the 2nd stage which consists of vacuum domes equipped with a vertical rise-and-fall guide, evacuation opening, and an atmospheric-air clear aperture. Conductive paste restoration equipment according to claim 8 to which the function which carries out evacuation of the air bubbles under paste with which beer was filled up by installing said 1st stage on said installation base at the time of paste restoration, and installing the 2nd stage on said installation base at the time of degassing, and carries out degassing was added.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In case this invention manufactures both sides used for various electronic equipment, or a multilayer-interconnection substrate, it is used, and it relates to the conductive paste restoration approach to minute beer, and conductive paste restoration equipment especially.
[0002]
[Description of the Prior Art] As 1st conventional example, the restoration approach of the hyperviscous conductivity paste currently indicated by JP,5-237986,A and the representative drawing of restoration equipment are shown in drawing 6 . Henceforth, a conductive paste is omitted and is described as a paste. This is equipment filled up with a paste using a roller squeegee to the penetrated beer. Make it close on the mask plate 605 which carried out close arrangement of the roller squeegee 604 on the base material 601, and it is made to move relatively to a base material 601, rotating the roller squeegee 604, and penetration beer 602 is filled up with a paste 603 through supply of a paste 603 on mask plate 605 front face. In addition, the mask hole 606 is established in the mask plate 605 so that it may agree in the location of penetration beer 602.
[0003] Next, restoration is explained. When it is made to rotate and is made to move horizontally to a base material 601 where the roller squeegee 604 is stuck to the mask plate 605, the paste 603 supplied to the migration direction front side of the roller squeegee 604 is involved in the migration direction back side by the turning effort of the roller squeegee 604. Furthermore, in case a paste 603 passes through between the

peripheral surface of the roller squeegee 604, and the front faces of the mask plate 605, the mask hole 606 and penetration beer 602 are filled up with a paste 603 by the peripheral surface of the roller squeegee 604, and it is pressed. At this time, it is high-density and a paste can be filled up into beer with the air in penetration beer 602 being discharged from the rear face of a base material 601 with the paste 603 filled up with and pressed.

[0004] The paste restoration equipment using the vacuum chamber for being filled up with a paste to a minute blind via as 2nd conventional example is shown in drawing 7 . After making into a vacua the inside of the vacuum chamber 703 connected with the evacuation means (not shown) in filling up with a paste 603 the minute blind via 702 prepared in the base material 701, a squeegee 704 is made to contact the front face of the mask plate 705 which carried out close arrangement on the base material 701. In addition, the mask hole 706 is established in the mask plate 705 so that it may agree in the location of the minute blind via 702.

[0005] Furthermore, a paste 603 is supplied to the squeegee 704 migration direction front side of mask plate 705 front face, a squeegee 704 is relatively moved to the mask plate 705, and printing spreading of the paste 603 is carried out on the mask plate 705. Then, by carrying out atmospheric-air disconnection of the inside of the vacuum chamber 703, it is more high-density to the minute blind via 702, and the paste 603 by which printing spreading was carried out is filled up with an operation of an atmospheric pressure into it.

[0006] Where the inside of the vacuum chamber 703 is made into a vacuum, when printing spreading of the paste 603 is carried out by the squeegee 704, it fills up with the paste 603 to the mask hole 706 established in the mask plate 705 at least, and the surface part of the minute blind via 702. Here, the non-filling opening of the paste 603 of minute blind-via 702 pars basilaris ossis occipitalis is in a vacua. Then, if atmospheric-air disconnection of the inside of the vacuum chamber 703 is carried out, supplement restoration of the paste 603 of finishing [having existing filled up the mask hole 706 of the mask plate 705] will be carried out by the differential pressure in the non-filling opening of the minute blind via 702 at a blind-via pars basilaris ossis occipitalis. Then, a squeegee 704 is made to contact on a base material 701, and the paste 603 which remains on a base material 701 is scratched.

[0007]

[Problem(s) to be Solved by the Invention] By detailed-ization of a conductive filler, when filling up minute beer with the hyperviscosity-ized paste, with the increment in printing number of sheets, it will decrease by the resinous principle and solvent component which are contained in a conductive paste adhering to a base material, or evaporating, paste viscosity will increase further, and paste restoration resistance will become large. Consequently, even if it carries out with a press operation of the paste by the peripheral surface of the rotating roller squeegee in the 1st conventional example, it is difficult to fill up minute beer with a hyperviscous paste certainly.

[0008] Moreover, after the 2nd conventional example makes the inside of a vacuum chamber a vacua, it needs to pass through the procedure of carrying out printing spreading of the paste in a squeegee, and carrying out atmospheric-air disconnection of the inside of a vacuum chamber further for restoration, and a process takes long duration to it. moreover, the device section which carries out printing spreading of the paste is built in a vacuum chamber -- it is necessary to make -- the equipment volume -- existing

**** -- since it is necessary to repeat said procedure at every paste restoration for every one base material, and to perform it to it while becoming large, productivity is fallen remarkably.
[0009] Furthermore, in the activity of a hyperviscous paste, in addition to vacuum degassing in a vacuum chamber tending to become uncertainty, degassing of the hyperviscous paste is repeatedly carried out at every printing spreading process within a vacuum chamber, and since the resinous principle added to the paste is discharged as gas, paste viscosity is raised still more remarkably in a short time. Therefore, a paste short shot and a paste activity cycle imitate buildup of the amount of the paste used accompanying compaction, and it is **.
[0010]
[Means for Solving the Problem] This invention can fill up with a hyperviscous paste certainly the minute beer prepared in the base material in consideration of the above-mentioned technical problem, can reduce the amount of the paste used, and aims at offering the paste restoration approach and paste restoration equipment excellent in productivity.
[0011] As a result of the experiment which the shearing stress defined by the product of the viscosity of a conductive paste and squeegee passing speed supplied ahead [squeegee] conducted beforehand, the 1st this invention controls squeegee passing speed, is high-density and certainly [beer / minute] relates to the paste restoration approach filled up with a paste so that it may be in agreement with shearing stress when the best restoration condition to the beer of a paste is shown. That is, when paste viscosity is small, the passing speed of a squeegee makes passing speed of a squeegee small as it is quick and paste viscosity becomes large.
[0012] It is the conductive paste restoration approach according to claim 1 characterized by the 2nd this invention controlling the passing speed of said squeegee to carry out adhesion maintenance of the rear-face side of a base material, to carry out adhesion arrangement of the squeegee at the front-face side of said base material, to supply a conductive paste ahead of the migration direction of said squeegee, and for the shearing stress detector attached in the squeegee edge to detect shearing stress, and to become fixed shearing stress. Then, the shearing stress detector attached in the edge of a squeegee detects shearing stress. It is the approach which controls the passing speed of said squeegee through squeegee control and an actuation circuit, and is filled up with the conductive paste to minute beer so that the detection value from a shearing stress detector and the value of shearing stress when the best restoration condition is shown as a result of the experiment conducted beforehand may become equal.
[0013] The 3rd this invention carries out adhesion maintenance of the rear-face side of a base material, and carries out adhesion arrangement of the squeegee at the front-face side of said base material. Supply a conductive paste ahead [of said squeegee / travelling direction], and the shearing stress detector attached in the squeegee edge detects shearing stress. It is paste restoration equipment which has the function in which the value of said shearing stress signal controls squeegee passing speed automatically as compared with the value of a shearing stress signal when the best restoration condition to the beer of the **-strike beforehand obtained by experiment is shown so that it may be in agreement. According to this equipment, even if viscosity changes, the passing speed of a squeegee is adjusted automatically, the best restoration condition in a paste in use is always

acquired stably, and the yield of a paste restoration activity, an efficiency rise, and reduction of paste consumption are attained.

[0014] In addition, the same effectiveness is acquired even if it attaches said shearing stress detector in the rise-and-fall shaft of a squeegee. In this case, although detection sensitivity becomes small, a paste does not adhere to a strain gage but a maintenance becomes easy.

[0015] The 4th this invention relates to the approach and paste restoration equipment which fill up a minute blind via with a paste. It is the approach of said 1st this invention, after filling up a blind via with a paste, said base material is made to reach a predetermined degree of vacuum, after carrying out degassing of the air bubbles under paste with which beer was filled up to the base material which prepared the minute blind via, it opens to atmospheric air at it, and again, it is the approach of said 1st this invention, and is the approach of filling up a minute blind via with a paste. Although 2 times of restoration processes are required for this approach, a paste can be certainly filled up into a blind via with high density.

[0016]

[Embodiment of the Invention] Hereafter, it explains, referring to the drawing of attachment of the gestalt of operation of this invention.

[0017] (Gestalt 1 of operation) A cross section shows the configuration of the base material concerning the gestalt 1 of operation, and beer to drawing 5 (a). As a base material 501, thickness used what stuck covering film 501b on both sides of base material film 501a which is about 0.02mm. moreover, the beer 502 whose bore diameter which minute beer irradiates ultraviolet laser from one covering film 501b page of a base material 501, and penetrates a base material 501 is about 0.05mm -- a predetermined location -- a predetermined number -- opening was carried out.

[0018] moreover, the inside of beer -- a conductor -- in order to form a circuit, the conductive paste which uses copper powder as a principal component was used as a paste with which beer 502 is filled up. said conductive paste -- as a conductive filler, the heat-curing mold epoxy resin (non-solvent mold) was used as resin, and the curing agent of an acid-anhydride system was used for the powder of copper with a mean particle diameter of 1 micrometer as a curing agent. The blending ratio of coal considered as 85 % of the weight of copper powder, 12.5 % of the weight of epoxy resins, and 2.5 % of the weight of curing agents, and was fully kneaded. Although the viscosity change by the restoration experiment using a squeegee was 30 Pa-S in front of restoration initiation, after finishing the restoration to the base material of about 100 sheets, when the resinous principle under paste adheres and permeated a base material front face, paste viscosity was rising to 150 Pa-S.

[0019] Next, the whole paste restoration equipment configuration in the gestalt 1 of operation is explained using drawing 1 (a). Paste restoration equipment consists of a pedestal 101, the version frame 102, the guide shaft 103, a squeegee 104, shearing stress detector 104c, base material 104a, the squeegee drive and squeegee control circuit (not shown) that were established in the interior of said base material, and vertical rise-and-fall guide shaft 104b. Shearing stress detector 104c prepares opening in the edge (the outside of a paste restoration field, within the limit [version]) of a squeegee 104, and is attached in the opening. In addition, when the base material is constituted by matrix arrangement of a unit wiring substrate, opening may be prepared in the squeegee section

corresponding to the borderline top of the unit wiring substrate in the migration direction of a squeegee, and a shearing stress detector may be attached in the opening. In addition, the same effectiveness is acquired even if it attaches said shearing stress detector in the soffit of the rise-and-fall shaft of a squeegee. In this case, although detection sensitivity becomes small, a paste does not adhere to a strain gage but a maintenance becomes easy.
[0020] It fills up beer with a paste for the passing speed of a squeegee 104 by [proper] passing a minute beer top, controlling, the equipment by said configuration detecting the shearing stress defined by the product of the viscosity of a paste, and the passing speed of a squeegee 104 supplied ahead [of a squeegee 104 / travelling direction] by shearing stress detector 104c while it carries out adhesion maintenance of the base material at a pedestal and carries out close arrangement of the squeegee 104 at the version frame 102.
[0021] Drawing 2 is the important section sectional view of paste restoration equipment, and explains a more detailed configuration. First, in order to carry out maintenance immobilization at homogeneity, the adsorption member 201 which prepared countless adsorption hole 201a for vacuum adsorption which consists of a porous sintered metal to an inside [appearance / of a base material 501] field is laid under the top face of a pedestal 101 at least, so that neither a wrinkle nor a wave may generate a base material 501. Two or more attraction slot 201b is prepared in the underside of the adsorption member 201, and after being concentrated mutually, evacuation of the attraction slot 201b is carried out by evacuation means (not shown), such as a vacuum pump, from evacuation opening 201c which penetrated and prepared the interior of a pedestal 101.
[0022] Furthermore, pedestal top-face 101a of the pedestal 101 including 201d of base material maintenance sides of adsorption member 201 top face is finish-machining in flatness of 0.02mm or less, and it carries out maintenance immobilization of the base material 501 at homogeneity, without a 201d [of base material maintenance sides] level difference occurring. In addition, thin paper 101e which has permeability with a uniform thickness [of the magnitude exceeding a base material 501 at least] of about 0.03mm between a base material 501 and 201d of base material maintenance sides is made to ****, and trespass of the paste 202 to adsorption hole 201a is prevented.
[0023] The version frame 102 which contacts a pedestal 101 at the periphery section except the paste restoration field of the base material 501 by which maintenance immobilization was carried out enables parallel rise-and-fall migration to 201d of base material maintenance sides with the version frame rise-and-fall guide (not shown) and the version frame rise-and-fall drive (not shown). Thereby, the uniform contact to the periphery section except the paste restoration field of the base material 501 of the version frame 102 is enabled.
[0024] Furthermore, 60 beveling was performed to the corner of two sides of said version frame 102 inner circumference which intersects perpendicularly in the squeegee migration direction at least, and ramp 102a made into the shape of knife edge whose neighboring point angle is 30 degrees is prepared. Moreover, mirror finish of the top face of ramp 102a and the version frame 102 is carried out by buffing. Thereby, migration of version frame 102 top face and ramp 102a in the time of squeegee contact can be performed smoothly.
[0025] The guide shaft 103 of a couple is mutually parallel above a pedestal 101, and erection support is carried out at parallel also to 201d of base material maintenance sides of the adsorption member 201. Base material 104a which attaches a squeegee 104 makes

actuation possible with drives (not shown), such as a ball screw or an air cylinder, at the guide shaft 103 while being attached through slide members, such as a slide bearing.
[0026] Thereby, base material 104a becomes movable to the base material 501 by which homogeneity maintenance was carried out at 201d of base material maintenance sides at the longitudinal direction of the guide shaft 103. Base material 104a is equipped with welding-pressure adjustment devices (not shown), such as vertical rise-and-fall guide shaft 104b and a regulator, and parallel are further equipped with the squeegee 104 to the base material 501 at the soffit section of vertical rise-and-fall guide shaft 104b. Thereby, a squeegee 104 can set up predetermined welding pressure in the vertical direction movable.
[0027] So, in this invention, opening was prepared in the edge (the outside of a paste restoration field, within the limit [version]) of a squeegee 104, and shearing stress detector 104c is prepared in the opening. The strain gage is used for the detection section of a shearing stress detector with the gestalt of this operation. Thereby, when a paste rolls by migration of a squeegee 104, a paste enters also all over stress detector 104c prepared in the squeegee 104. A detecting signal occurs by a strain gage bending according to a floating operation of the paste, and deforming. If the bending deformation of a strain gage will also become large, a signal level will increase, if a detecting signal is in the deformation and functional relation of a strain gage and the passing speed of a squeegee 104 is gathered, and the passing speed of a squeegee 104 is reduced, the bending deformation of a strain gage will become small and a signal level will decrease.
[0028] Moreover, even when the passing speed of a squeegee 104 is fixed, along with the increment in paste viscosity, the amount of bending of a strain gage becomes large, and a signal level increases. The signal level by the strain gage from this is the product of the viscosity of a paste, and the passing speed of a squeegee, i.e., the function of shearing stress. Even if the number of sheets of the paste restoration to a base material increases and paste viscosity increases, the paste restoration to beer which was trustworthy and was stabilized is attained by adjusting the passing speed of a squeegee 104 so that said signal level may be in agreement with a signal level when the good restoration condition to the beer of a paste is shown.
[0029] The paste restoration actuation to the base material to which opening of the beer was carried out is explained in detail using drawing 4 . Vacuum maintenance immobilization is carried out through thin paper 101e at 201d of base material maintenance sides, and the base material 501 is pressed down in the periphery section except a paste restoration field with the version frame 102. The squeegee 104 shown with a broken line is in the squeegee initial position P1 of the version frame 102 upper part, and supplies a fill required for the base material of the number of predetermined leaves on the version frame 102 using supply means, such as a dispenser, by the width of face which covers a restoration field for a paste 202 at least. Next, as a continuous line shows, a squeegee 104 is dropped to the squeegee migration starting position P2 on the version frame 102. At this time, a squeegee 104 is close to the version frame 102 by the predetermined pressure.
[0030] Next, if a squeegee 104 is moved to an arrow-head travelling direction in the condition of having been close to the version frame 102, while being run through one's paste 202 supplied on the version frame 102, the strain gage which constitutes shearing stress detector 104c deforms in a floating operation of a paste 202, and generates the

signal level by distortion. The initial value of paste viscosity was 30 Pa-S, the restoration property with the squeegee optimal passing speed good at a part for 3000mm/was acquired, and the signal level of the shearing stress detector at that time was W. Then, it is made to move smoothly, maintaining predetermined welding pressure, and the ramp 102a and base material [the version frame 102 by which mirror finish was carried out, and] 501 top is made to scan to the squeegee migration termination location P3 further.
[0031] When a squeegee 104 reaches the minute beer 502 prepared during migration at the base material 501, a paste 202 is conjointly pushed in one by one in minute beer 502 with the vacuum suction effect of the adsorption member 201 through thin paper 101e. Here, it is adsorbing the resinous principle contained in the paste 202 with which minute beer's 502 was filled up, while preventing the blinding of the adsorption member 201 to depend paste 202, and thin paper 101e also has the effectiveness with which it filled up of increasing the filling factor of ****.
[0032] Next, while a squeegee 104 goes up, and the squeegee for scrapings (not shown) descends and gathering up a paste to a restoration starting position, the squeegee 104 has also returned to the initial position P1. In addition, in order that the squeegee for scrapings may move by the predetermined pressure in a base material 501 top, a paste 202 does not remain in the field except the minute beer 502 on a base material 501.
[0033] At the above process, it finishes, and on the occasion of restoration of the paste to the base material of the 2nd sheet, squeegee passing speed is controlled by the control circuit (not shown), and the paste restoration process to the first base material of one sheet is set up by it so that the detecting signal from a shearing stress detector may be set to W. For example, although paste viscosity rose to 80 Pa-S by adhesion in the base material of the resinous principle contained in a paste 202, osmosis, and volatilization at the 30 printing number-of-sheets event, it was controlled so that the signal level of a shearing stress detector was set to W by the squeegee control circuit, and the passing speed of the squeegee 104 at that time was a part for 1200mm/. In this case, although paste viscosity rose by about 3 times, paste restoration was good like the base material of an one-sheet side.
[0034] Furthermore, although adhesion in the base material of the resinous principle contained in a paste 202, osmosis, and volatilization progressed further and paste viscosity rose to 150 Pa-S at the 100 printing number-of-sheets event, it was controlled so that the signal level of a shearing stress detector was set to W by the squeegee control circuit, and the passing speed of the squeegee 104 at that time was a part for 600mm/. In this case, paste restoration was good although paste viscosity rose twice [about] further. Therefore, even if the viscosity of a paste rises by controlling the passing speed of a squeegee in each restoration cycle, and carrying out restoration actuation to it so that it may become the value from which a good restoration property is acquired in the signal level of a shearing stress detector, restoration of the paste to minute beer can be performed stably.
[0035] Although the shearing stress detector detected the signal level for every paste restoration cycle to a base material and squeegee passing speed is set up through a squeegee control circuit with the gestalt of this operation, when fluctuation of the viscosity of a paste is loose, for every restoration process which is a number cycle, a stress detector may detect a signal level and squeegee passing speed may be set up through a squeegee control circuit.

[0036] (Gestalt 2 of operation) The cross section of the base material which carried out opening of the blind via concerning the gestalt 2 of operation is shown in drawing 5 (b). With the gestalt of this operation, thickness carried out the laminating of the base material film 503a which is about 0.02mm, and used what stuck covering film 503c on both sides further as a base material 503 for what carried out patterning of the copper foil 503b with a thickness of about 0.01mm to base material film 503a whose thickness is about 0.02mm. Moreover, minute beer irradiated ultraviolet laser from one covering film 503c page of a base material 503, and carried out predetermined number formation of the blind via 504 whose bore diameter which uses a copper foil 503b front face as a base is about 0.05mm in the predetermined location. moreover, the inside of beer -- a conductor -- the paste with which a blind via 504 is filled up in order to form a circuit is the same as that of what used a component, a compounding ratio, and viscosity with the gestalt 1 of operation.

[0037] In the minute blind via 504 without the recess path of air, since vacuum attraction using the adsorption member 201 which differed in the base material 501 of penetration beer structure, and minded thin paper 101e cannot be performed, restoration is performed at three steps shown below.

[0038] The configuration of the paste restoration equipment in the gestalt of this operation is explained using drawing 1 (b) and drawing 3 . Drawing 1 (b) is the mimetic diagram of the paste restoration equipment in the gestalt of this operation. The version frame installed on the installation base equipped with the O ring which inserted this paste restoration equipment in the O ring slot, A guide shaft, a squeegee, a squeegee base material, and a squeegee drive, A squeegee control circuit and the shearing stress detector attached in the edge or squeegee base material of a squeegee, It consists of the 2nd stage which consists of vacuum domes equipped with the 1st stage which consists of vertical rise-and-fall guide shafts and the flange installed on said installation base, a vertical rise-and-fall guide, evacuation opening, and an atmospheric-air clear aperture. It is paste restoration equipment to which the function which carries out evacuation of the air bubbles under paste with which beer was filled up, and carries out degassing was added by installing said 1st stage on said installation base at the time of paste restoration, and installing the 2nd stage on said installation base at the time of degassing.

[0039] Drawing 3 is the important section sectional view of the equipment which evades the air bubbles under paste in the gestalt of this operation, and shows the condition that the vacuum dome 106 which counters is descending, toward the installation base 105. in order to carry out positioning installation of the base material 503 in a predetermined location at the installation base 105 -- the appearance of a base material 503 -- every about 1mm -- an outside -- and with a height of about 2mm base material regulation frame 105c was prepared. Furthermore, O ring 105b is inserted in 105d of installation base top faces as a sealing means with flange 106a of the vacuum dome 106 at O ring slot 105a, buffing performs mirror finish for the contact surface with O ring 105b of O ring slot 105a and flange 106a, and adhesion is raised.

[0040] The vacuum dome 106 has countered with 105d of installation base top faces, and vacuum dome rise-and-fall guide shaft 106b of a couple makes rise and fall possible by driving means (not shown), such as an air cylinder, while being guided vertically at rise-and-fall guide 106e. Flange 106a is prepared in the configuration jutted out outside along with the soffit periphery of the vacuum dome 106, and is unified with sufficient

airtightness by the vacuum dome 106 and welding. It is made into the minimum volume while making it not interfere in the interior of the vacuum dome 106 with base material regulation frame 105c prepared in the installation base 105.
[0041] Moreover, it prepared so that evacuation opening 106c might be opened for free passage inside the vacuum dome 106, and it has connected with sources of an external vacuum (not shown), such as a vacuum pump, through a vacuum pressure regulator (not shown). Furthermore, it prepares so that 106d of atmospheric-air clear apertures may be opened for free passage inside the vacuum dome 106, and it is open for free passage with atmospheric air through the closing motion valve (not shown) interlocked with the detector (not shown) which detects the pressure in a vacuum dome.
[0042] By this, the vacuum dome 106 descends, and where sufficient adhesion is obtained in contact with O ring 105b, flange 106a By carrying out evacuation, it becomes possible from evacuation opening 106c to make the vacuum dome 106 interior reach to predetermined vacuum pressure for a short time. The signal at the time of predetermined degree of vacuum attainment of the vacuum pressure detector formed in evacuation opening 106c is detected, and atmospheric-air disconnection prompt to predetermined degree of vacuum attainment and coincidence is enabled for the closing motion valve by open Lycium chinense.
[0043] Next, the restoration approach of the paste to the blind via in the gestalt of this operation is explained. First, in first step, the passing speed of a squeegee is controlled proper and the minute blind via 504 is filled up with a paste 202 so that adhesion maintenance of the base material 503 may be carried out and it may become the same as that of the signal-level value which shows a good restoration property beforehand using the 1st same stage as the gestalt 1 of operation about the signal level which detected the paste 202 supplied ahead [of a squeegee / travelling direction] with the shearing stress detector.
[0044] However, in the minute blind via 504 without the recess path of air, since vacuum attraction of the adsorption member 201 which differed in the base material 501 of penetration beer structure, and minded thin paper 101e cannot be performed, the restoration condition of a paste 202 is especially imperfect, and when a paste 202 is stuffed into the base of the minute blind via 504 by the squeegee, air bubbles remain. In the paste restoration field of a base material 503, a line crack and a paste 202 have such a condition in an imperfect restoration condition to all the minute blinds via 504 repeatedly. Drawing 3 shows the condition that the base material 503 by which paste restoration was carried out beforehand was laid in the location regulated by base material regulation frame 105c prepared in the installation base 105.
[0045] Drop the vacuum dome 106 and flange 106a is made to contact O ring 105b, evacuation was performed and the inside of the vacuum dome 106 was made to decompress from evacuation opening 106c in the second step. Here, the air bubbles which remain in the minute blind via 504 are discharged by the degassing operation out of the minute blind via 504 with the reduced pressure in the vacuum dome 106. the paste whole with which all the blinds via 504 that prepared the degassing in the base material 503 are filled up since a base material 503 has the whole in the vacuum dome 106 -- and it acts simultaneously. Minutely, since vacuum dome 106 content volume of the volume of the air bubbles which remain to the minute blind via 504 is also small, it completes for a short time and cellular degassing in a paste can do reduced pressure for a short time.

[0046] The air bubbles which remained on the base are removed in the degassing operation, and with an atmospheric pressure, the paste 202 with which it filled up in the minute blind via 504 at the time of atmospheric-air disconnection serves as a gestalt in which only the amount of cellular volume dented the paste side on the top face of a blind via, although the connection with copper foil 503b of minute blind-via 504 base becomes perfect.
[0047] Next, in the third step, the base material [finishing / cellular degassing of the minute blind via 504] 503 carries out supplement restoration by repeating again the procedure of early paste restoration into the part into which the paste side on the top face of a blind via was dented on the 1st same stage as the gestalt 1 of operation. Thereby, it fills up with a paste 202 thoroughly, without air bubbles remaining in a minute blind via.
[0048] In addition, the same effectiveness is acquired even if it changes this invention into a configuration as shown below, without being limited only to the gestalt of the above-mentioned implementation.
[0049] (a) Although the gestalt which fills up with a paste the minute beer prepared in the base material was described, the paste restoration approach of this invention is applicable also to printing and restoration of a paste which used the screen mask, the metal mask, etc.
[0050] (b) Squeegee migration may carry out 1 or more ****s not only of an one direction but squeegee migration.
[0051] (c) In the gestalt 2 of operation, although it is the device which a vacuum dome goes up and down, the device which an installation base goes up and down is sufficient.
[0052] (d) Without limiting to what was divided, using a roll sheet-like base material, the function of a feed zone and the rolling-up section is added to equipment, and a base material can also carry out continuation restoration.
[0053] (e) A base material is not limited to what was used with the gestalt of this operation, and can be applied also to a ceramic green sheet etc.
[0054]
[Effect of the Invention] Above, this invention can fill up certainly with a paste the minute beer or the minute blind via prepared in the base material, can reduce the amount of the paste used further, and can offer the paste restoration approach and paste restoration equipment which were excellent also in productivity so that clearly from explanation. In the production process of a high density wiring substrate, it is very effective, and the effectiveness on the industry is size.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) The mimetic diagram of the paste restoration equipment in the gestalt 1 of operation of this invention
(b) The mimetic diagram of the paste restoration equipment in the gestalt 2 of operation of this invention
[Drawing 2] The sectional view of the paste restoration equipment in the gestalt 1 of operation of this invention
[Drawing 3] The important section sectional view of the law evasion equipment of the air

bubbles under paste in the gestalt 2 of operation of this invention
[Drawing 4] Drawing explaining the paste restoration actuation in the gestalt 1 of operation of this invention
[Drawing 5] (a) The sectional view of the base material which carried out opening of the minute beer used by this invention
(b) The sectional view of the base material which carried out opening of the minute blind via used by this invention
[Drawing 6] Drawing showing the paste restoration equipment by the paste restoration approach by the 1st conventional example
[Drawing 7] Drawing showing the paste restoration equipment by the paste restoration approach by the 2nd conventional example
[Description of Notations]
101 Pedestal
102 Version Frame
103 Guide Shaft
104 Squeegee
104c Shearing stress detector
105 Installation Base
106 Vacuum Dome

S/N 10/709,327 ART UNIT

Translation of Japanese 2003-276159

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The airline printer characterized by being the airline printer which forms a circuit element in a printing hand-ed by printing, having two or more printing means by which it can load with a lithographic plate which is different in each, and performing gradual printing by said two or more printing means to a printing hand-ed.
[Claim 2] The airline printer characterized by a conveyance means to be an airline printer according to claim 1, and to convey said printing hand-ed between the arrangement locations of said printing hand-ed in each printing by said two or more printing means having a maintenance means to hold a printing hand-ed in case said each printing is performed.
[Claim 3] The airline printer characterized by having further a desiccation means to be an airline printer according to claim 1 or 2, and to dry the circuit element formed in said printing hand-ed.
[Claim 4] The printing approach which is the printing approach which forms a circuit element in a printing hand-ed by printing, and is characterized by forming said circuit element gradually to the printing hand-ed of 1 by performing gradually printing using the lithographic plate in which each makes said circuit element form selectively.
[Claim 5] The printing approach characterized by having further the desiccation process which it is the printing approach according to claim 4, and dries said circuit element whenever a circuit element is gradually formed in said printing hand-ed.
[Claim 6] The printing approach characterized by forming said circuit element gradually, being the printing approach according to claim 4 or 5, printing a printing-position reference point collectively in the first printing, and adjusting the location of said printing hand-ed on the basis of said printing-position reference point in subsequent printing.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the technique which forms circuit elements, such as lead wire and a solder bump, in the circuit board by printing.
[0002]
[Description of the Prior Art] Since it has the merit that film formation is cheaply possible, thick-film-screen-printing techniques are easy and a technique widely used as a technique which forms the circuit pattern containing circuit elements, such as lead wire in an electron device etc., an electrode, a resistor, and a solder bump.

[0003] In thick film screen printing, circuit formation to the substrate concerned is performed by printing a circuit pattern using the lithographic plate created corresponding to the desired circuit pattern in the paste which mixed ingredient powder, such as a conductor, with the organic solvent with the glass frit etc. to printing hands-ed, such as a green sheet which constitutes substrates, such as a semi-conductor, and ceramics, glass, a multilayer substrate, and a laminating device, and **'s also calcinating the substrate concerned, and making only ingredient powder sinter.

[0004]

[Problem(s) to be Solved by the Invention] When the penetration version tends to be used for a lithographic plate and it is going to perform the above thick film screen printing, the circuit patterns 1001, 1002a, and 1002b shown in drawing 9 (a) cannot be formed. It is because the part which is equivalent to the slash sections 1003 and 1004 in a lithographic plate serves as an isolated field linked to none of other parts of a lithographic plate, so this part cannot be held actually.

[0005] Moreover, when it is the circuit pattern with which the long and slender line 1005 as shown in drawing 9 (b) crowds, the part isolated like drawing 9 (a) is not produced, but when spacing of 1006 between lines which attached the slash is small, the reinforcement of the lithographic plate in this part runs short, and a line 1005 may be unable to be just reproduced on a substrate. In order to avoid such the very thing, when printing such a long and slender line 1005 etc., as shown in drawing 9 (c), a bridge 1007 is formed, and maintaining the reinforcement between lines is often performed. However, since it was unnecessary to an original circuit pattern, this bridge 1007 was removed by trimming by laser etc. after formation of a circuit pattern.

[0006] Although formation of the above circuit patterns is possible if photolithography is used, utilization of photolithography has the fault that cost is high. Therefore, although formation of the circuit pattern considered so that it was not necessary to use a circuit pattern by devising these circuit designs is also made, there is a trouble that the degree of freedom of a design is restrained.

[0007] Although this invention is made in view of the above-mentioned technical problem and the penetration version is used for it, it aims at offering the airline printer which can make the degree of freedom of a wiring design high more.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention of claim 1 is an airline printer which forms a circuit element in a printing hand-ed by printing, is equipped with two or more printing means by which it can load with a lithographic plate which is different in each, and is characterized by performing gradual printing by said two or more printing means to a printing hand-ed.

[0009] Moreover, invention of claim 2 is an airline printer according to claim 1, and is characterized by a conveyance means to convey said printing hand-ed between the arrangement locations of said printing hand-ed in each printing by said two or more printing means having a maintenance means to hold a printing hand-ed in case said each printing is performed.

[0010] Moreover, invention of claim 3 is an airline printer according to claim 1 or 2, and is characterized by having further a desiccation means to dry the circuit element formed in said printing hand-ed.

[0011] Moreover, invention of claim 4 is the printing approach which forms a circuit

element in a printing hand-ed by printing, and is characterized by forming said circuit element gradually to the printing hand-ed of 1 by performing gradually printing using the lithographic plate in which each makes said circuit element form selectively.
[0012] Moreover, invention of claim 5 is the printing approach according to claim 4, and is characterized by having further the desiccation process which dries said circuit element whenever a circuit element is gradually formed in said printing hand-ed.
[0013] Moreover, invention of claim 6 is the printing approach according to claim 4 or 5, and it is characterized by forming said circuit element gradually, it printing a printing-position reference point collectively in the first printing, and adjusting the location of said printing hand-ed on the basis of said printing-position reference point in subsequent printing.
[0014]
[Embodiment of the Invention] <Gestalt <configuration of airline printer> of the 1st operation> drawing 1 is the block diagram showing the configuration of the airline printer 1 concerning the gestalt of operation of the 1st of this invention. Drawing 2 is drawing showing the approach of printing in an airline printer 1 typically. In the production process of an electron device, by making substrates, such as a semi-conductor and liquid crystal, into a printing hand-ed, the airline printer 1 concerning the gestalt of this operation is for forming the circuit pattern containing circuit elements, such as lead wire, and an electrode, a bump, using printing of viscous matter, such as soldering paste, and has the description that two or more lithographic plates perform sequential printing, to the substrate of 1 in that case. However, the lithographic plate used in the airline printer 1 concerning the gestalt of this operation presupposes that it is the penetration version with which the penetration section was formed corresponding to the circuit pattern for which it asks. That is, what the breakthrough corresponding to a pattern was able to open in the sheet metal tabular object or the thin film-like object is used as a lithographic plate, and printing is performed by imprinting to a substrate the paste extruded from this breakthrough.
[0015] An airline printer 1 is mainly equipped with a control section 2, the substrate conveyance section 3, the stage actuator 4, the printing section 5, the source 6 of nitrogen gas supply, and the paste supply source 7, as shown in drawing 1 . In addition, the printing section 5 consists of 1st printing section 5a and 2nd printing section 5b in the gestalt of this operation. Although this responds to performing two steps of printings with two different lithographic plates, it may be a mode which prints much more phases in an airline printer 1.
[0016] A control section 2 controls actuation of each part which an airline printer 1 mentions later according to directions of an operator, and it is equipped in order to perform printing.
[0017] The substrate conveyance section 3 delivers the substrate 9 given from the outside of an airline printer 1 to a stage 42 in accordance with a predetermined substrate conveyance path, and is equipped with the substrate conveyance means 31 for making it discharge after termination of printing.
[0018] The stage actuator 4 mainly has the stage 42 in which a substrate 9 is laid on the occasion of printing, and the stage driving means 41 which moves it to a horizontal direction and a perpendicular direction. When the stage driving means 41 moves a stage 42, printing in 1st printing section 5a mentioned later and printing in 2nd printing section

5b can be continuously performed to the substrate 9 of 1. That is, after printing in 1st printing section 5a is completed first, the stage driving means 41 moves a stage 42 to the printing position in 2nd printing section 5b like an arrow head AR 1, and presents printing in 2nd printing section 5b with a substrate 9 succeedingly. Since a substrate is not moved by this whenever it performs each printing, the arrangement relation of the substrate 9 to a stage 42 is always kept constant, and the location precision of printing is secured.

[0019] The fundamental configuration and fundamental operation of 1st printing section 5a of the printing section 5 and 2nd printing section 5b are the same, and printing to a substrate 9 is performed by pressurizing and extruding a paste also in any. Therefore, 1st printing section 5a is equipped with the 1st application-of-pressure printing means 51, and 2nd printing section 5b is equipped with the 2nd application-of-pressure printing means 52, respectively. The detail of the printing section 5 is later mentioned including the process of application-of-pressure printing.

[0020] The source 6 of nitrogen gas supply is for supplying the nitrogen gas used as a source of application of pressure in the case of application-of-pressure printing to the printing section 5. The paste supply source 7 is for supplying the component slack paste which constitutes a circuit pattern to the printing section 5.

[0021] Application-of-pressure printing made in 1st printing section 5a and 2nd printing section 5b of <application-of-pressure printing>, next the printing section 5 is explained.

[0022] If it is the case of 1st printing section 5a as shown in drawing 2 , the 1st application-of-pressure printing means 51 is equipped with the application-of-pressure container 53. The upper part of the application-of-pressure container 53 has the shape of a cylinder of a cylindrical shape, and the lower part has the configuration which can carry out maintenance immobilization horizontally with a fixed means by which a substrate 9 is not illustrated. The part of the shape of a upside cylinder is equipped with the piston 55 which arranged O ring 54 on the perimeter, and the nitrogen gas supplied from the source 6 of nitrogen gas supply flows from the topmost part up to the upper part of a piston. The 1st application-of-pressure printing means 51 is equipped with the bulb 57 and regulator 58 for controlling the inflow of this nitrogen gas. Moreover, it is the side face of a cylinder-like part, and more below than a piston 55, the paste feed hopper 56 is equipped and a paste 10 is caudad supplied by the piston 55 from the paste supply source 7.

[0023] If a paste 10 is supplied from the paste supply source 7 and it fills up with a paste 10 below the piston 55 of the application-of-pressure container 53 after fixed maintenance of the lithographic plate 8a is carried out at the lower part of the application-of-pressure container 53, as an arrow head AR 2 shows to a piston 55, it will be depressed below by the pressure of nitrogen gas by controlling a bulb 57 and a regulator 58. Since a paste 10 also receives application of pressure in connection with this, a paste 10 will be extruded from the penetration section 13 currently formed in lithographic plate 8a, and it will imprint to the substrate 9 arranged directly under. In addition, printing is possible if the substrate 9 is approaching even the condition of a substrate 9 and lithographic plate 8a not being in the condition which not necessarily touched, and having left the gap slightly, in this case. Adjustment of both spacing is performed when the stage driving means 41 moves a stage 42 in the vertical direction.

[0024] Since the same of the component and the process of printing is said of the 2nd application-of-pressure printing means 52 with which 2nd printing section 5b is

equipped, explanation is omitted.
[0025] By using the airline printer 1 concerning <gradual printing of a circuit pattern>, next the gestalt of this operation explains gradual printing of a circuit pattern which becomes possible. Here, when gradual printing of a circuit pattern uses two or more lithographic plates, the printing approach of making the circuit pattern for which it asks to the printing object domain of 1 of a substrate forming is said, and complex printing which more specifically prints the part (for example, an isolated field and the field of the perimeter) which became intricate mutually in the printing object domain of 1 with another lithographic plate is equivalent to this. Drawing 3 is drawing showing typically the process of gradual printing of a circuit pattern of having used the airline printer 1. Drawing 4 is drawing showing the flow of this process. In drawing 3 and drawing 4 , since explanation is easy, the case where the circuit pattern shown in drawing 9 (a) is printed is considered. As mentioned above, with the lithographic plate of 1, the isolated field can produce these circuit patterns and cannot print them. So, in gradual printing in the gestalt of this operation, the circuit pattern for which it asks is formed by decomposing so that an isolated field may not produce a circuit pattern, dividing into two lithographic plates, forming, and performing two steps of printings using these lithographic plates. Hereafter, this is explained.
[0026] First, as shown in drawing 3 (a), the 1st lithographic plate 21 and the 2nd lithographic plate 22 are prepared. Some circuit patterns 24 and 25 (pattern part which these become intricate mutually and should be formed) disassembled beforehand are formed in these lithographic plates, respectively. After these lithographic plates are set to 1st printing section 5a and 2nd printing section 5b, respectively, the substrate 23 conveyed by the substrate conveyance means 31 from the predetermined stowed position is laid in a stage 42, and is arranged under the 1st lithographic plate 21 (step S1). In addition, in 1st printing section 5a and 2nd printing section 5b, processing required for printings, such as supply of a paste, is made in the meantime, respectively. And printing will be performed, if a stage 42 moves like an arrow head AR 4 and approaches the 1st lithographic plate 21 (step S2).
[0027] Printing by the 1st lithographic plate 21 is completed, and if the partial circuit pattern 26 is formed in a substrate 23 as shown in drawing 3 (b), a stage 42 will be moved to the bottom of the 2nd lithographic plate 22 like an arrow head AR 5 (step S3). and only predetermined time amount is made to stand by here in order to carry out until desiccation of the partial circuit pattern 26 with which the point was formed to some extent (step S4)
[0028] Termination of desiccation standby performs printing of the remaining circuit patterns by the 2nd lithographic plate 22 shortly, as an arrow head AR 6 shows to drawing 3 (c) (step S5). After this is completed, as shown in drawing 3 (d), the circuit pattern 27 for which it asks will be obtained. By the substrate conveyance means 31, the substrate 23 which printing ended is discharged from 2nd printing section 5b, and desiccation processing is presented with it (step S6).
[0029] As mentioned above, as explained, by printing by the lithographic plate of 1, formation of the circuit pattern which was not able to be formed becomes possible also in printing by decomposing so that an isolated field may not be generated, dividing a circuit pattern into two lithographic plates, forming it beforehand, and performing two steps of printings using these lithographic plates. Thereby, the degree of freedom of a circuit

design when forming a circuit pattern by presswork becomes high. Moreover, since formation of a circuit pattern with an isolated field does not need a photolithography process by the ability carrying out in presswork, a cost cut can be aimed at.
[0030] In addition, if it is two steps when forming a line like drawing 9 (b) by gradual printing, forming is possible by every other printing with one lithographic plate.
[0031] With the gestalt of <gestalt of the 2nd operation> the 1st operation, although the special desiccation means was not established, in the gestalt of this operation, the case where an airline printer is equipped with a substrate dryer part is explained.
[0032] Drawing 5 is the block diagram showing the configuration of the airline printer 100 concerning the gestalt of operation of the 2nd of this invention. Drawing 6 is drawing for explaining the configuration of the substrate dryer part 110.
[0033] As shown in drawing 5 , if the point that the substrate dryer part 110 is formed is removed, the airline printer 100 concerning the gestalt of this operation will be the same configuration as the airline printer 1 concerning the gestalt of the 1st operation, and will omit about them the explanation which attached the same sign.
[0034] The substrate dryer part 110 is mainly equipped with the exhaust air means 113 connected with drying room 111 and the heater 112 formed in the interior for drying room 111 and piping.
[0035] A dry room 111 can contain a substrate 114 to the interior with the condition of having been laid at the stage 42. A heater 112 is for heating the circuit pattern 115 currently formed in the substrate 114 which was formed above the location where a substrate 114 is contained, and was contained, and drying this. Since the exhaust air means 113 makes the gas which occurs by performing desiccation processing to a circuit pattern 115 in drying room 111 exhaust compulsorily from drying room 111, it is equipped by it.
[0036] Next, the process of printing in the gestalt of this operation is explained. Drawing 7 is drawing showing this flow. It is the same as the gestalt of the 1st operation until a substrate 114 is laid in a stage 42 and printing by the 1st lithographic plate is made (steps S11 and S12). Then, a substrate 114 is transported to a dry room 111 the whole stage 42, as an arrow head AR 7 shows drawing 6 (step S13). And stoving at a heater 112 is made in drying room 111 (step S14). Thereby, since it can be made to dry quickly and certainly, it is avoidable that deformation arises in the already printed partial circuit pattern etc. with latter printing processing etc. Moreover, since the solvent component which volatilizes from a paste is compulsorily exhausted by the exhaust air means 113, an operator's safety is also secured.
[0037] After desiccation processing is completed, as an arrow head AR 8 shows drawing 6 , a stage 42 is moved to under the 2nd lithographic plate (step S15), and printing by the 2nd lithographic plate is made (step S16). And after printing is completed, a substrate 114 will be again transported to drying room 111 (step S17), and desiccation processing will be again discharged after a carrier beam (step S18) (step S19).
[0038] As mentioned above, as explained, since the airline printer 100 concerning the gestalt of this operation is equipped with the substrate dryer part 110, for every phase of printing of a circuit pattern, it can be made to be able to dry early and certainly and it can avoid deformation of the already printed partial circuit pattern etc. Moreover, an operator's safety is secured by that of since the solvent component which volatilizes from a paste can be made to exhaust compulsorily.

[0039] In the gestalt of the <modification> above-mentioned operation, although each was explained only about two steps of printings, it is also possible by having the printing section further to print more phases.
[0040] In the gestalt of above-mentioned operation, although it was the response to which a paste 10 is supplied from the common paste supply source 7 to both 1st printing section 5a and 2nd printing section 5b, you may be a mode equipped with the paste supply source corresponding to each. In this case, the circuit pattern which the 1st lithographic plate prints, and the circuit pattern which the 2nd lithographic plate prints can be formed with a different paste.
[0041] Moreover, in gradual printing of a gradual circuit pattern, it is important that a location gap does not arise in the partial circuit pattern printed in each phase. For that purpose, the mode which positions a substrate with a sufficient precision and is printed is desirable.
[0042] Drawing 8 is drawing showing an example about the positioning approach. First, as shown in drawing 8 (a), apart from the circuit pattern, the pattern 28 for positioning is beforehand formed in the 1st lithographic plate 21. If printing by the 1st lithographic plate 21 is made, the positioning mark 29 which consists of three points will be formed with the partial circuit pattern 26. And it detects with an image-processing means by which the location of this positioning mark 29 of three points is not illustrated in the case of printing in the 2nd lithographic plate 22 etc. Since the location gap from the original location of the substrate 9 corresponding to the 2nd lithographic plate 22 can be found by this, according to the result, the stage driving means 41 will tune the location of a stage 42 finely, as shown in an arrow head AR 9. Thereby, in gradual printing, the location precision of the partial circuit pattern printed in each phase can be raised more.
[0043]
[Effect of the Invention] As mentioned above, since the circuit element which was not able to be formed in printing only using the lithographic plate of 1 can be formed according to invention of claim 1 thru/or claim 6 as explained, the degree of freedom of a circuit design increases. Moreover, since the circuit element concerned can be formed without being based on photolithography, cost can be reduced.
[0044] Since a printing hand-ed is not especially moved for whenever [of printing by each lithographic plate / every] according to invention of claim 2, a circuit element can be formed with a sufficient location precision.
[0045] especially, according to invention of claim 3 and claim 5, it is avoidable that deformation arises in some circuit elements which were alike previously and were printed etc. Moreover, since the solvent component which volatilizes from a circuit element formation ingredient can be exhausted compulsorily, an operator's safety is securable.
[0046] Since the location of a printing hand-ed can be finely tuned especially for whenever [of printing based on a reference point / every] according to invention of claim 6, the printing-position precision at the time of forming the circuit element gradually can be improved more.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the airline printer 1 concerning the gestalt of the 1st operation.
[Drawing 2] It is drawing showing the approach of printing in an airline printer 1 typically.
[Drawing 3] It is drawing showing typically the process of gradual printing of the circuit pattern using an airline printer 1.
[Drawing 4] It is drawing explaining the process of gradual printing of a circuit pattern.
[Drawing 5] It is the block diagram showing the configuration of the airline printer 100 concerning the gestalt of the 2nd operation.
[Drawing 6] It is drawing for explaining the configuration of the substrate dryer part 110.
[Drawing 7] It is drawing explaining the process of printing in the gestalt of the 2nd operation.
[Drawing 8] It is drawing showing an example about the positioning approach.
[Drawing 9] It is drawing explaining printing by the conventional penetration version.
[Description of Notations]
1,100 Airline printer
8a, 8b Lithographic plate
9 23 Substrate
10 Paste
13 Penetration Section
21 1st Lithographic Plate
22 2nd Lithographic Plate
111 Drying Room
112 Heater
113 Exhaust Air Means
114 Substrate
115 Circuit Pattern
27 Circuit Pattern
42 Stage
53 Application-of-Pressure Container
54 O Ring
55 Piston